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The Esthetic Effects of Prescribed Burning: A Case Study[1]

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Scenic values were compared for two 10-acre ponderosa pine plots, both logged, but one with a prescribed burn to remove slash. The burned plot was significantly less attractive immediately following the burn, but significantly more attractive 1 year later. Recovery on both plots reached an apparent asymptote after 3 years.

Keywords: Scenic beauty, prescribed burning, public evaluation, ponderosa pine, harvesting

Management Implications

Scenic values for an area where logging slash had been treated with prescribed fire were lower than for an adjacent unburned area immediately after the fire. However, at the end of the 1st and 2nd year, the burned area recorded higher scenic values than the unburned area. Over the subsequent 3-year period scenic values remained essentially the same for the two areas.

Introduction

Prescribed burning is an increasingly important forest management tool. The benefits of burning downed wood and logging residues can include the reduction of wildfire hazards (Martin and Brackebush 1974, Moore 1976), improvement in wildlife habitat (Euler 1975), increases in water and forage yields (Clary et al. 1974, Euler 1975), and improved regeneration and growth conditions for several tree species (Dils 1974, Moore 1976). The effects of fire on scenic quality have been the object of some concern (Dils 1974, Mobley 1974, Moore 1976, Viereck 1973), but to date, little empirical investigation has been undertaken on this question. Most authors agree that the immediate visual effects of fire are negative. Some authors (e.g., Mobley 1974, Viereck 1973) have described eventual scenic improvements resulting from fire.

Knowledge of the effect of prescribed burning on scenic quality would result in improved forest management decisions. In particular, quantification of the effects of fire on the public's esthetic evaluation of wildlands would allow the scenic resource to be considered in fire-decision models (e.g., Kessell 1976) along with the physical benefits of wood, water, forage, and soil conservation.

There is good reason to suspect that the reduction of downed wood by fire could eventually result in enhanced scenic quality. There is general agreement in the literature (e.g., Benson 1974, Daniel and Boster 1976, Dils 1974, Hakkila 1974, McGee 1970, Wagar 1974) that

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downed wood and logging residues detract from scenic quality. Empirical evidence supports this assertion. For southwestern ponderosa pine (*Pinus ponderosa* Dougl. ex Laws) forests, the amount of downed wood is a strong negative linear correlate of measures of public perception of scenic quality (Schroeder and Daniel 1981). Arthur (1977) found that the negative scenic impact of downed wood accounted for more variance in scenic evaluations than any other physical feature of the ponderosa pine forest. Daniel and Boster (1976) reported a correlation of −0.87 between the amount of downed wood in a scene and scenic quality judgments rendered by the public. The removal of residues after logging in Wyoming lodgepole pine (*P. contorta* Dougl. ex Loud.) forests was found to reduce by 50% the esthetic loss imposed by the logging operation (Benson 1974).

Based on this evidence, one would expect scenic quality to improve with the removal of downed wood. However, when prescribed burning is the method used to remove debris, other visual effects of the fire may detract from scenic beauty. Also, because evidence of fire may persist for some time, knowledge of the time-course of scenic recovery after a fire is essential.

Method

The study reported here examined the esthetic effects of broadcast burning of logging slash in southwestern ponderosa pine. Landscapes were photographed prior to the burn, within a month after the burn, and periodically during the next 5 years. After the last photographs were collected, esthetic evaluations were obtained using the Scenic Beauty Estimation (SBE) method, developed by Daniel and Boster (1976). This method has been applied successfully to a variety of scenic evaluation problems in southwestern ponderosa pine and other forests (Arthur 1977, Benson 1974, Daniel et al. 1977, Schomaker 1979). The SBE procedure is based on observers' ratings of scenic attractiveness of color slide representations of landscapes. Previous research has established the representational validity of color slides in landscape research (Daniel and Boster 1976). The method transforms the ratings using a psychophysical scaling procedure (Thurstone 1927) to produce standardized measures of the difference in observers' perception of the esthetic quality of each scene relative to a designated set of scenes (such as a set of scenes from an untreated forest area). Conclusions can be drawn concerning the relative magnitude of differences in scenic quality rather than just the rank-order of the areas under study. Additional details concerning the scaling procedure can be found in Daniel and Boster (1976).

Study Area

The study area was on the Coconino National Forest in Arizona. The site was selectively logged prior to 1975, and the resultant slash was lopped and scattered. A plot to be burned and an adjacent control plot were selected, each about 10 acres in size.

The results of a fuel inventory are shown in the following tabulation:

Plot	**Diameter class (inches)**		
	0-3	**3+**	**Total**
	----- *tons per acre* -----		
Control	4.2	10.6	14.8
Burn (before treatment)	7.8	9.8	17.6
Burn (after treatment)	2.7	7.0	9.7

The fire consumed 44% of all material on the burned plot; fine fuels were reduced by 65%; the 3-inch and larger fuels by 28%—about normal for a fall burn in scattered ponderosa pine slash.

Photosample Collection

The two plots were photographed on six occasions between August 1975 and September 1980, to represent the late summer-early fall season over the 6-year study period. The late summer season allows full development of vegetative ground cover and generally precedes heavy frosts in the study area. On each sampling occasion, both plots were photographed on the same day. At least 25 color slides (35 mm) were taken of each plot on each occasion. A systematic photosampling scheme was adopted for all sample collections. Photographs were taken at fixed distances along the perimeter and diagonals of the plot. The perimeter photographs were oriented into the plot, perpendicular to the border. Photos from points on the plot diagonals were oriented at random compass headings. Scenes which consisted of views through one plot into another plot or into surrounding, nonrepresentative areas were omitted.

The first pair of burn and control plot samples was obtained in early August, after logging but prior to burning of the treatment plot. The ground cover was near its peak volume and greenness at this time. A second pair of samples (one each of burn and control plots) was taken approximately 3 months later, immediately after the burn. The remaining pairs of photosamples were taken in September of 1976, 1977, 1979, and 1980.

Before the slides were presented to observers for evaluation, they were inspected for correct focus, exposure, and color development quality. Slides that were photographically unacceptable were rejected. Following this screening, all but 3 photosamples had at least 25 slides. One photosample of 23 slides and 2 of 24 slides each were expanded to 25 slides by using 1 or 2 randomly-selected slides from each photosample twice. Slides were deleted at random from the larger photosamples to reduce them to 25 slides each. The 6 pairs of photosamples constituted a set of 300 slides.

Obtaining Scenic Beauty Estimates

The slides from the September 1977 control plot photosample were selected to be baseline slides; that is, the slides whose ratings would serve as the origin of the SBE scale. This set of slides was shown to all observer panels for this study, so that comparisons between observer

panels could be made and to allow comparison of scenic beauty estimates derived from each panel.

The remaining slides through the September 1979 photosample (225 total) were divided into 9 groups on a stratified basis, so that each group of slides had approximately the same number of slides from each photosample. Eight of these 9 groups of slides were brought up to a total of 125 slides each by addition of 71 or 72 other slides from the Coconino National Forest. These additional slides were of the same ponderosa pine forest type and were part of a different study. The ninth group of slides was composed of photosamples of burn and control plots from September 1980, the 25 baseline slides, and 45 slides sampled from among those shown to the other 8 groups so that it also had a total of 125 slides.

All the slides in each group were shown to observer panels in random order, with the exception that every fifth slide shown was one randomly drawn from the baseline set (September 1977 control plot photosample).

Observers were 247 University of Arizona student volunteers, divided into 9 panels numbering from 21 to 34 students. Because the focus of this study was on the change in scenic beauty following prescribed burning, the composition of the observer panels was determined by availability. Previous research has demonstrated, however, that college students give esthetic evaluations very similar to those given by other representatives of the public (Arthur 1977, Brush 1979, Buhyoff and Leuschner 1978, Daniel and Boster 1976, Hodgson and Thayer 1980).

At the beginning of the evaluation sessions, observers received a rating response sheet showing the 0-9 (low to high) rating scale they were to use to rate the attractiveness of the scenes. The sheet also contained columns of numbered response blanks for recording evaluations.

Observers were advised that the purpose of the study was to assess the scenic quality of various landscapes to provide information for better land management decisions. The observers were then instructed to assign a single value between 0 and 9 to each scene according to their judgment of the attractiveness of each scene. A sample of 10 of the slides to be rated in the session was shown to illustrate the type of scenes to be evaluated. The 125 slides were then projected for evaluation on a 2 m by 2 m projection screen. The first 60 slides were shown for 8 seconds each. After this practice in following the procedure, observers rated the remaining 65 slides at 5-second intervals.

The ratings were scaled using the SBE algorithm (Daniel and Boster 1976) which provided relative standardized SBE values for each slide. The arbitrary origin (zero-point) of the SBE scale was the mean SBE value derived for the set of 25 slides (September 1977 control plot) which was rated by all observer panels.

To verify the equivalence of the 9 groups of students who evaluated the slides, the ratings of the 25 common slides for each group were examined. The SBE values for these slides were correlated for each pair of groups. The product-moment correlations ranged from 0.61 to 0.86 with a median of 0.74 across the 36 possible pairs of groups. Overall, there was reasonably good agreement among these groups, but not as good as has been found in some previous studies (e.g., Daniel et al. 1977). The baseline slides, upon which observer group agreement was assessed, were all from the control plot September 1977. As Schroeder and Daniel (1980) have shown, intergroup correlations will be low if variability among the comparison slides is low. This seems to have been the case in the present study.

Two additional observer groups ($N = 30$ and 31) rated sets of slides that had either 49 scenes in common with 1 of the groups used in this study or 51 scenes in common with that group. Based on this expanded and more variable set of common slides, intergroup correlations were 0.79 and 0.85, respectively. Further, with the exception of September 1980, slides from all study conditions were distributed among all observer groups, so SBE's from all groups were combined to provide an analysis of prescribed burn effects.

Results

The mean Scenic Beauty Estimates for the burn and control plots for each post-burn photosample are shown in figure 1. Both plots were judged essentially equal in scenic value in August 1975 prior to burning, with SBE's of 27 and 26 for burn and control, respectively. These values are relatively high, reflecting the fact that vegetative growth is generally at the peak of volume and greenness at this time of year.

Immediately following the burn (November 1975) both the control and burn plots were much lower in scenic value. Of course, vegetative ground cover was no longer green on either plot, and the burn plot displayed very prominent charring and other evidence of the recent fire.

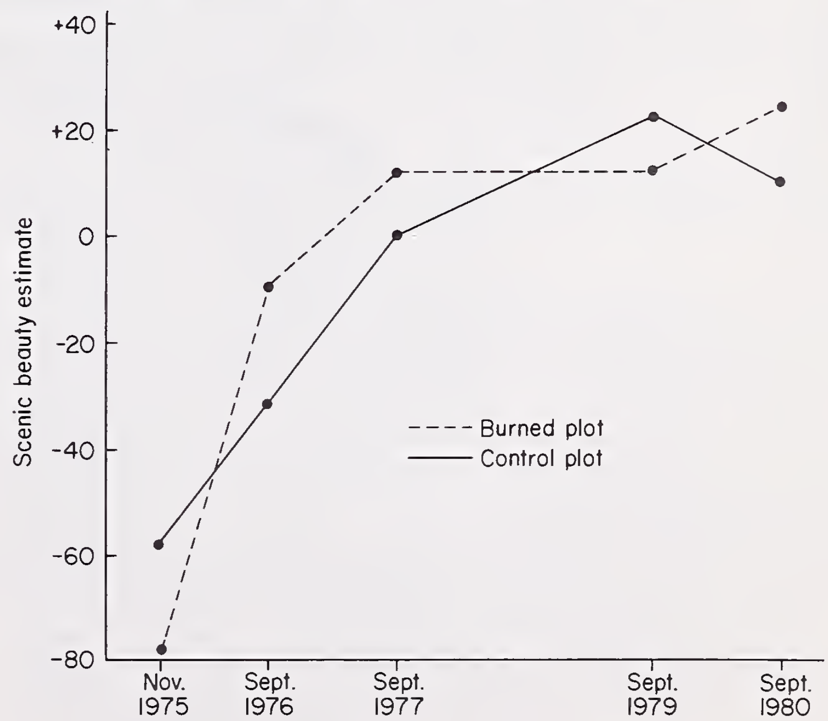

Figure 1.—Scenic Beauty Estimates for burned and control plots following prescribed burning. Values plotted are means across 25 slides at each plot on each date. The 1975 sample was taken in November because burning was delayed until October. No 1978 sample was available.

In the years following, both plots showed significant improvement, in part because of annual variations in vegetation and ground cover. Moreover, both plots were in the process of recovering from the effects of the initial harvest and, in the case of the burn plot, the subsequent broadcast burn. Though substantially lower immediately after the burn, by September 1976 the burn plot had overtaken and exceeded the control plot in scenic value.

Scenic values for both sites improved during the 1976-1977 period, the burned plot still maintaining a slightly more favorable SBE index. No photographs were taken in 1978. In 1979 the SBE index for the unburned plot was slightly higher than the burned plot. SBE values for the two sites had changed again by 1980 when final photographs were taken but the difference between the two sites was small, indicating nearly equal scenic beauty estimates.

The reliability of the data in figure 1 was tested by a two-factor analysis of variance design, examining the effects of treatment (burn vs. control) and time (six samples from November 1975 to September 1980). The 25 slides within each treatment-time condition provided the replications on which the error term for the analysis was based. The overall effect of time was statistically significant, $F(4, 240) = 68.56$, $p < .01$, which is quite consistent with the apparent trend seen in figure 1. The effect of treatment per se was not significant ($F < 1$), but in interaction with time, it had a significant short-term influence on scenic quality ($F(4, 240) = 4.18$, $p < .01$).

The nature of the interaction effect is evident in figure 1, with burn plot values beginning well below the control initially, and then overtaking or surpassing them in the later samples. Post-hoc analysis of the interaction effect employed a Scheffe multiple comparison procedure (Winer 1962) comparing burn and control means at each sample time. This analysis confirmed that the burn plot was significantly below the control immediately after the fire, $F(1, 240) = 5.09$, $p < .05$, and was higher than the control in the September 1976 sample, $F(1, 240) = 6.23$, $p < .05$. No other comparisons of burn and control means achieved statistical significance.

Three additional photosamples of these study plots were taken in late spring and early summer of 1976, 1977, and 1978. Ground covers were generally very sparse at this time of year, and scenic values were low for both plots; -18, -1, and -13 for the burn plot and -24, -27, and -20 for the control plot for the three successive year samples. As for the late summer samples during this period, the burn plot was consistently judged more attractive than the control. This may indicate a positive effect of prescribed fire on early forbs and ground covers. Also, in addition to the immediate post-burn sample (November 1975) another November sample was taken in 1976. The burn plot and control were judged essentially equal in scenic value with mean SBE's of -3 and -6, respectively. At this season of the year, vegetative ground covers are well browned and may offer little advantage to the burned plot. In either the early summer or late fall case, however, there were no appropriate pre-burn samples available, so any conclusions about specific burn effects must be tentative.

Discussion

The results of this case study suggest that the scenic effects of prescribed burning may depend on the time frame of the evaluation. Immediately after burning, scenic values were substantially lower than those for a comparable, unburned site. Within a year, however, scenic values on the burn site surpassed those on the unburned plot. In subsequent years, the burn-plot scenic values were essentially equal to those for the control.

From an esthetic perspective, prescribed burning appears to have only very short-term negative effects. Further, there is some indication in the present study that burning could help to mitigate some of the adverse effects of timber harvests. As an immediate effect, fire may stimulate more rapid growth of forbs and other green ground covers, covering skid trails and other scars and adding a positive scenic element to a harvested stand. When heavy slash accompanies a harvest, burning might provide more long-term scenic benefits by reducing the scenically negative downed wood and litter.

In the present study, broadcast burning was applied to a rather open and mature ponderosa pine stand that had been selectively cut. Slash volumes were not heavy, and there was little disturbance of the forest floor. Thus, the potential for scenic gains from burning was not great. Nonetheless there were significant improvements over the control plot in the short-term, and the judged scenic values of the burn plot compared favorably with those of the control throughout the subsequent years studied. Adverse scenic impacts, then, were very short-lived under the conditions of this study and should not be a significant deterrent to prescribed burning under similar conditions.

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